

and drawn so that the vectors shall be central on the circles I, II, III, which run through the middle of the respective adopted subareas. In order to get some idea of the average cyclonic and anticyclonic vectors in the different levels, the mean values of the vectors found on the circles I, II, III, respectively, were taken, and these give the relations between the inner and the outer portions of the masses of air in motion in cyclones and anticyclones. They are shown in Charts 17 and 18. To secure one more concentration of the data, and to further eliminate the local defects, the nine levels were reduced to three by taking the means of the three upper, the three middle, and the three lower strata together, respectively, and these are shown on Chart 19. The following small Table 7 gives the corresponding numerical results; it is Table 52 of the cloud report.

TABLE 7.—Mean components grouped in three levels.*

MEAN ANTICYCLONIC COMPONENTS.		I.	II.	III.
Upper level. Cl., Cl. S., Cl. Cu.	u_2	— 3.3	+ 3.9	+ 2.2
	v_2	— 4.5	— 5.2	— 4.8
	σ	5.6	6.5	5.3
	β	234	307	294
Middle level. A. S., A. Cu., S. Cu.	u_2	0.0	+ 4.2	— 0.8
	v_2	— 7.1	— 6.6	— 9.3
	σ	7.1	7.9	9.3
	β	270	303	265
Lower level. Cu., S., Wind.	u_2	+ 3.3	+ 3.0	+ 1.8
	v_2	— 4.1	— 7.0	— 6.2
	σ	5.3	7.6	6.4
	β	308	294	287

MEAN CYCLONIC COMPONENTS.

		I.	II.	III.
Upper level. Cl., Cl. S., Cl. Cu.	u_2	— 1.2	— 6.8	— 1.8
	v_2	+10.2	+12.3	+ 0.7
	σ	10.3	14.0	2.0
	β	96	119	161
Middle level. A. S., A. Cu., S. Cu.	u_2	— 7.3	+ 0.3	+ 1.6
	v_2	+18.6	+14.4	+ 5.2
	σ	20.0	14.4	5.5
	β	111	89	73
Lower level. Cu., S., Wind.	u_2	+ 0.3	— 2.4	— 1.5
	v_2	+ 7.9	+ 6.3	+ 3.8
	σ	8.0	6.7	4.2
	β	88	111	112

* Copy of Table 52.

It is evident that it would be of great advantage to meteorology to have similar observations continued systematically in the United States, so as eventually to obtain perfectly reliable vectors of motion throughout the atmosphere, and they should be extended to all parts of the world as rapidly as practicable. It is not very safe to draw conclusions extending to the entire atmosphere from the observations made at a few selected localities, such as those in the United States or Europe, but it seems to be necessary for us to do so in the present incomplete state of meteorology. Moreover, we must use the material we now have in discussing what are the fundamental principles of dynamics that can be admitted into the theory, and accordingly I shall proceed to take up the observed general circulation and the local circulations, and compare them with the existing theories in order to arrive at such views as will probably determine the theoretics of the dynamic meteorology of the future.

NOTES AND EXTRACTS.

MR. C. F. R. WAPPENHANS.

Mr. Carl F. R. Wappenhans, for many years a member of the Signal Corps and of the Weather Bureau, died at Arco, Switzerland, February 4, 1902. Mr. Wappenhans was born at Berlin, Prussia, in 1834, served as an officer in the United States Navy from 1862 to 1868, joined the Signal Corps on January 9, 1871, was placed on the retired list as first class

sergeant on December 28, 1891, was appointed local forecast official in the Weather Bureau on the same date, and resigned on August 31, 1901. He was in charge of the station at Indianapolis, Ind., from January 30, 1871, until the date of his resignation, with the exception of four years, from 1879 to 1882, when he was in charge of Detroit, Mich. Mr. Wappenhans was a man of most kindly and genial disposition, and a faithful and efficient official.—H. E. W.

THE WEATHER OF THE MONTH.

By Prof. ALFRED J. HENRY, in charge of Division of Records and Meteorological Data.

CHARACTERISTICS OF THE WEATHER FOR FEBRUARY.

The weather of February, 1902, was much like that of February, 1901. In the interior low temperatures and great dryness prevailed while on both coasts the precipitation was above the seasonal average. A remarkable feature of the month was the persistence of a ridge-shaped area of high pressure that extended from Tennessee northwestward evidently beyond the field of observation. This ridge of high pressure seems to have been formed and maintained by the movement southeastward along the eastern slope of the Rocky Mountains in Brit-

ish Columbia of areas of high pressure of rather small extent, yet sufficient to prevent areas of low pressure from crossing the Rocky Mountains in the neighborhood of the forty-eighth parallel of latitude. All of the storms of the month therefore except the last one moved southeasterly over the Plateau region to the Texas coast, thence easterly along the Gulf coast, and northeastward along the Atlantic coast to New England. As in 1901 a great depression persisted over the North Atlantic off the Canadian Maritime Provinces. Pressure was also remarkably low off the north Pacific coast and the rainfall in that region was extraordinarily heavy. The temperature was

below the seasonal average in the southeastern part of the country and above in the northwestern part.

PRESSURE.

The distribution of monthly mean pressure is shown graphically on Chart IV and the numerical values are given in Tables I and VI.

The monthly mean pressure was three-tenths of an inch below the normal on the north Pacific coast and over two-tenths below the normal on the north Atlantic coast. It was also below the normal in the interior districts by amounts ranging from .03 to .20 inch.

The distinctive feature of the month was a ridge of high pressure that covered the middle Mississippi and Missouri valleys and stretched northwestward into British Columbia.

Not a single low crossed the Rocky Mountains in the neighborhood of the forty-eighth parallel of latitude.

As compared with the previous month, there was a marked fall in pressure in all districts, save in the extreme southern portion of California.

TEMPERATURE OF THE AIR.

The distribution of monthly mean surface temperature, as deduced from the records of about 1,000 stations, is shown on Chart VI.

The month was unusually cold in the central valleys and the southeastern part of the country, where the negative departures ranged from 5° in Florida to 10° and over in the lower Ohio Valley, Tennessee, and the middle Mississippi Valley. In New England and thence westward, through the lower Lake region, to the Pacific coast, including all the country westward of the Rocky Mountains, temperature was above the seasonal average by amounts ranging from 4° in New England to 12° in the upper Mississippi Valley and 8° over the Plateau region.

The average temperature for the several geographic districts and the departures from the normal values are shown in the following table:

Average temperatures and departures from normal.

Districts.	Number of stations.	Average temperatures for the current month.	Departures for the current month.	Accumulated departures since January 1.	Average departures since January 1.
New England	8	26.3	0.0	-1.0	-0.5
Middle Atlantic	12	29.2	-5.3	-7.3	-3.6
South Atlantic	10	41.7	-7.9	-10.6	-5.3
Florida Peninsula	8	56.0	-5.8	-8.2	-4.1
East Gulf	9	46.1	-8.5	-10.0	-5.0
West Gulf	7	46.7	-4.9	-5.1	-2.6
Ohio Valley and Tennessee	11	28.4	-9.8	-10.5	-5.2
Lower Lake	8	21.9	-4.7	-5.1	-2.6
Upper Lake	10	20.0	+0.9	+4.2	+2.1
North Dakota	8	11.9	+4.4	+13.1	+6.6
Upper Mississippi Valley	11	20.6	-5.5	-1.2	-0.6
Missouri Valley	11	21.2	-3.2	+2.7	+1.4
Northern Slope	7	21.1	+4.8	+10.6	+5.3
Middle Slope	6	32.3	-0.2	+1.6	+0.8
Southern Slope	6	41.3	+0.3	+1.5	+0.8
Southern Plateau	13	43.1	+1.6	+3.8	+1.9
Middle Plateau	9	44.6	+6.7	+8.3	+4.2
Northern Plateau	12	35.6	+6.1	+7.9	+4.0
North Pacific	7	45.1	+4.6	+5.2	+2.6
Middle Pacific	5	51.6	+2.4	+1.2	+0.6
South Pacific	4	54.0	+0.6	+2.2	+1.0

In Canada.—Prof. R. F. Stupart says:

The mean temperature of the month was decidedly above average over the northern portions of the Dominion and above to a less extent in the southern portions, except in the southwestern counties of Ontario where it was from 1° to 3° below. In the extreme north of Quebec, Ontario, Manitoba, and in the Territories, the positive departures exceeded 12°; and that this wide difference from average probably extended to the Arctic Ocean is indicated by the Dawson City mean which was 8.8°, fully 12° or more above normal.

PRECIPITATION.

Heavy rains fell over a narrow strip of country, extending from southern Mississippi and Alabama northeastward into North Carolina, and torrential rains also fell on the Pacific coast from central California northward to the Straits of Fuca; elsewhere precipitation was below the seasonal average and this was particularly so in the Ohio Valley where less than one-half inch of precipitation was recorded during the month. Heavy snows fell over the mountain districts of California and Oregon. There was also more than the usual amount of snow in North Carolina, in the western portion of South Carolina, Tennessee, southern Missouri, and northern Arkansas. At the end of the month practically all of the snow had disappeared except in the mountain districts of Pennsylvania, western New York, New England, on the Upper Peninsula of Michigan, in the Missouri Valley and in the mountain districts of the West.

Average precipitation and departure from the normal.

Districts.	Number of stations.	Average.		Departure.	
		Current month.	Percentage of normal.	Current month.	Accumulated since Jan. 1.
		<i>Inches.</i>		<i>Inches.</i>	<i>Inches.</i>
New England	8	4.07	114	+0.5	-1.3
Middle Atlantic	12	4.69	138	+1.3	+0.3
South Atlantic	10	4.33	121	+0.8	-1.9
Florida Peninsula	8	4.92	163	+1.9	-0.4
East Gulf	9	6.09	133	+1.5	-1.4
West Gulf	7	1.73	50	-1.7	-2.8
Ohio Valley and Tennessee	11	1.61	38	-2.6	-3.6
Lower Lake	8	1.21	45	-1.5	-2.4
Upper Lake	10	1.10	58	-0.8	-2.1
North Dakota	8	0.93	148	+0.3	-0.1
Upper Mississippi Valley	11	0.88	47	-1.0	-1.8
Missouri Valley	11	0.64	52	-0.6	-0.8
Northern Slope	7	0.33	62	-0.2	-0.7
Middle Slope	6	0.34	40	-0.5	-1.0
Southern Slope	6	0.08	8	-0.9	-1.7
Southern Plateau	13	0.61	60	-0.4	-0.9
Middle Plateau	9	1.37	117	+0.2	-0.4
Northern Plateau	12	2.44	149	+0.8	-0.4
North Pacific	7	12.11	198	+6.0	+3.3
Middle Pacific	5	10.46	258	+6.4	+2.5
South Pacific	4	4.04	155	+1.4	0.0

In Canada.—Professor Stupart says:

The rainfall seems to have been somewhat greater than average, both on Vancouver Island and the lower mainland of British Columbia. In the Northwest Territories the snowfall was above average over the larger part of Assinibola and about average elsewhere, while in Manitoba there was a slight excess in the more western portions of the Province and a deficiency in the eastern portions. From Manitoba eastward to the Maritime Provinces there was a fairly general deficiency of precipitation, except a slight excess in the Ottawa Valley and in Cape Breton, in the first instance owing to the exceptionally heavy snowstorm of the 2d, and in the second to a large number of falls of rain or snow at intervals during the month.

SLEET.

The following are the dates on which sleet fell in the respective States:

Alabama, 2, 5, 6, 14, 15, 16, 21, 25. Arkansas, 1, 2, 3, 5, 10, 13, 14, 15, 19, 20, 24, 27. California, 4, 7, 11, 16, 20, 25, 26, 27, 28. Colorado, 6, 15, 18, 22, 26, 27. Connecticut, 1, 2, 21, 22. Delaware, 20, 21. District of Columbia, 2, 20, 21. Florida, 4, 5, 9. Georgia, 5, 14, 15, 16, 20. Idaho, 5, 14, 15, 24, 26, 27, 28. Illinois, 2, 20, 28. Indiana, 1, 10, 19, 20, 21, 28. Indian Territory, 19. Iowa, 26, 27, 28. Kansas, 1, 12, 13, 14, 15, 19, 20, 28. Kentucky, 20, 21, 28. Louisiana, 3, 4, 5. Maine, 2, 18. Maryland, 1, 2, 3, 20, 21, 22. Massachusetts, 2, 17. Michigan, 7, 9, 13, 14, 28. Minnesota, 20, 26, 27, 28. Mississippi, 1, 4, 5, 14, 21. Missouri, 1, 5, 6, 13, 14, 19, 20, 28. Montana, 10, 16, 18, 26, 27, 28. Nebraska, 13. Nevada, 5, 7, 14, 17, 22, 25, 26, 27, 28. New Hampshire, 2, 17. New Jersey, 1, 2, 17, 21, 22. New Mexico, 25, 26, 27. New York, 2, 21, 22. North Carolina, 1, 2, 15, 16, 20, 21, 22, 25. North Dakota, 25, 26, 28. Ohio, 20, 21, 26, 27. Oklahoma, 14, 19, 20. Oregon, 4, 6, 7, 8, 27.

Pennsylvania, 1, 2, 20, 21, 22. South Carolina, 14, 15, 16, 17, 18, 20, 21, 22. South Dakota, 13, 15, 17, 18, 27. Tennessee, 13, 14, 17, 18, 19. Texas, 4, 5, 8, 19, 25. Utah, 5, 17, 22, 24, 25, 26. Vermont, 2, 3, 26. Virginia, 1, 15, 16, 17, 20, 21, 22, 27, 28. Washington, 4, 5, 6, 7, 8, 14, 15, 24, 25, 28. West Virginia, 1, 2, 21, 22, 25. Wisconsin, 27, 28. Wyoming, 8, 9, 13, 26, 28.

HAIL.

The following are the dates on which hail fell in the respective States:

Alabama, 5, 14, 15, 24, 27. Arizona, 26. Arkansas, 10, 13, 14, 17, 19, 20, 24, 27. California, 12, 25, 26, 27. District of Columbia, 28. Florida, 21, 24, 27, 28. Georgia, 21, 27, 28. Indiana, 28. Kentucky, 28. Louisiana, 6, 19, 23, 24, 27. Maryland, 28. Mississippi, 14, 27, 28. North Carolina, 28. Ohio, 28. Oregon, 4, 5, 7, 10, 12, 17, 25, 26, 27, 28. South Carolina, 27, 28. South Dakota, 26. Texas, 19, 23, 24. Utah, 17, 22, 24, 26, 27, 28. Washington, 6, 9, 20, 26, 27, 28. West Virginia, 28.

HUMIDITY.

The average by districts appear in the subjoined table:

Average relative humidity and departures from the normal.

Districts.	Average.	Departure from the normal.	Districts.	Average.	Departure from the normal.
New England	75	0	Missouri Valley	80	+ 3
Middle Atlantic	74	0	Northern Slope	78	+ 9
South Atlantic	72	- 6	Middle Slope	70	+ 4
Florida Peninsula	79	- 3	Southern Slope	56	- 14
East Gulf	71	- 7	Southern Plateau	40	- 8
West Gulf	73	0	Middle Plateau	62	0
Ohio Valley and Tennessee	77	+ 3	Northern Plateau	79	+ 1
Lower Lake	82	+ 12	North Pacific	83	- 12
Upper Lake	82	+ 1	Middle Pacific	86	+ 10
North Dakota	79	- 12	South Pacific	79	+ 8
Upper Mississippi Valley	80	+ 3			

SUNSHINE AND CLOUDINESS.

The distribution of sunshine is graphically shown on Chart VII, and the numerical values of average daylight cloudiness, both for individual stations and by geographical districts, appear in Table I.

The averages for the various districts, with departures from the normal, are shown in the table below:

Average cloudiness and departures from the normal.

Districts.	Average.	Departure from the normal.	Districts.	Average.	Departure from the normal.
New England	5.6	+ 0.1	Missouri Valley	5.8	+ 0.4
Middle Atlantic	5.7	+ 0.1	Northern Slope	6.0	+ 1.2
South Atlantic	5.2	- 0.1	Middle Slope	5.3	+ 0.9
Florida Peninsula	4.9	+ 0.3	Southern Slope	4.8	0.0
East Gulf	6.3	+ 0.8	Southern Plateau	3.1	+ 0.1
West Gulf	5.8	0.0	Middle Plateau	6.3	+ 1.5
Ohio Valley and Tennessee	6.3	+ 0.1	Northern Plateau	8.1	+ 1.4
Lower Lake	6.8	0.0	North Pacific	8.3	+ 1.3
Upper Lake	5.9	+ 0.4	Middle Pacific	7.9	+ 3.1
North Dakota	5.8	+ 0.7	South Pacific	5.4	+ 1.3
Upper Mississippi Valley	5.1	- 0.2			

WIND.

The maximum wind velocity at each Weather Bureau station for a period of five minutes is given in Table I, which also gives the altitude of Weather Bureau anemometers above ground.

Following are the velocities of 50 miles and over per hour registered during the month:

Maximum wind velocities.

Stations.	Date.	Velocity.	Direction.	Stations.	Date.	Velocity.	Direction.
Amarillo, Tex.	18	57	nw.	Mount Tamalpais, Cal.	25	59	s.
Do.	19	51	n.	Nantucket, Mass.	22	53	w.
Do.	26	67	sw.	Do.	23	55	sw.
Block Island, R. I.	2	72	w.	Do.	17	64	e.
Do.	9	70	w.	Do.	22	50	ne.
Do.	17	53	w.	Neah Bay, Wash.	11	56	e.
Do.	17	72	ne.	New Haven, Conn.	3	52	w.
Do.	18	50	nw.	New York, N. Y.	22	74	w.
Buffalo, N. Y.	2	54	w.	Do.	3	62	w.
Do.	3	63	w.	Do.	8	53	nw.
Do.	4	59	sw.	Do.	9	55	nw.
Do.	5	56	w.	Do.	13	50	nw.
Do.	7	50	w.	Do.	18	62	nw.
Chicago, Ill.	4	50	w.	Do.	19	51	nw.
Cleveland, Ohio	28	64	se.	Do.	28	68	se.
Columbia, S. C.	28	52	sw.	Oswego, N. Y.	3	52	nw.
Denver, Colo.	27	50	nw.	Pensacola, Fla.	27	52	sw.
Eastport, Me.	2	54	e.	Point Reyes Light, Cal.	14	55	se.
Do.	17	54	ne.	Do.	16	66	s.
El Paso, Tex.	26	71	w.	Do.	17	58	s.
Do.	27	51	nw.	Do.	20	63	se.
Do.	28	56	nw.	Do.	21	54	s.
Jacksonville, Fla.	28	55	s.	Do.	23	78	se.
Lexington, Ky.	28	50	w.	Do.	24	60	se.
Modena, Utah	26	54	nw.	Do.	25	98	se.
Mount Tamalpais, Cal.	16	60	sw.	Red Bluff, Cal.	25	60	se.
Do.	17	52	sw.	Winnemucca, Nev.	12	52	sw.

ATMOSPHERIC ELECTRICITY.

Numerical statistics relative to auroras and thunderstorms are given in Table IV, which shows the number of stations from which meteorological reports were received, and the number of such stations reporting thunderstorms (T) and auroras (A) in each State and on each day of the month, respectively.

Thunderstorms.—Reports of 975 thunderstorms were received during the current month as against 357 in 1901 and 104 during the preceding month.

The dates on which the number of reports of thunderstorms for the whole country were most numerous were: 28th, 337; 27th, 182; 26th, 75.

Reports were most numerous from: Georgia, 75; California, 63; Oregon, 58.

Auroras.—The evenings on which bright moonlight must have interfered with observations of faint auroras are assumed to be the four preceding and following the date of full moon, viz: 18th to 26th.

In Canada: A thunderstorm was reported from New Westminster on the 21st. Auroras were reported as follows: Port Arthur, 25th; Minnedosa, 2d, 7th; Qu'Appelle, 6th; Battleford, 2d, 3d, 8th, 11th; Port Simpson, 9th, 12th.

DESCRIPTION OF TABLES AND CHARTS.

By ALFRED J. HENRY, Professor of Meteorology.

For description of tables and charts see page 570 of REVIEW for December, 1901.